

Device/User Interface Software Requirements For General Data Products 783 BPSK Subcarrier / Modulator

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1.0 Introduction

This document provides device and user interface requirements for the General Data Products 783 –M Multi-channel Subcarrier Generator / Bi-Phase Shift Keyed (BPSK) Modulator

2.0 Required Functionality

The BPSK modulator is a device within the Data Handling Node. The device includes four BPSK modulators, a digital signal interface and a signal summer/level control module.

The four individual modulators will be described first.

Each of the individual modulator sections contain a tunable subcarrier frequency generator, an internal pseudo-random-noise (PRN) generator, and a digital BPSK modulator. The GDP 783-M accepts a variety of input sources to feed its modulators. The 783-M accepts RS-422 level command data on four different lines, as well as an external analog signal. The internal PRN data can be selected in place of the external data inputs. The external inputs are first connected to the digital interface module.

The digital signal interface will be described next.

The four PSK modulator outputs, along with the two Digital Baseband signals, and the external analog input signal then can be connected to a summing section to create a composite output signal. Up to four of the seven signals may be selected for the summer.

The signal summer/ level control module will be described next.

Independent power level adjustment and on/off control is provided on the summer for each of the four signals that are inputs to the summer, as well as selectable attenuation of the composite output. The composite output signal will be in the form of a sine wave.

Four PSK modulator outputs are also provided as separate outputs on the rear panel separate from the feeds that may be selected for routing to the summer. Independent on/off selection and power level adjustment for these independent signals are provided on each modulator.

This device will be used as part of the Command Uplink path from the Data Handling Node on into the Antenna Node. This device will be connected to other devices in the telemetry signal data path by way of its signal input/output ports. This device's input/output ports will be switched through an Analog Matrix Switch. Moreover, the command input port of this device will be connected to its node computer through a Digiboard switchable serial port controller. The full capabilities of this device will be used.

3.0 Parameter Ranges

The needs of ground station implementation will not require parameter limits that are different than those which are standard to the device.

The General Data Products 783 Subcarrier Generator / Bi-Phase Shift Keyed (BPSK) Modulator has the following range and parameter limits.

- Internal Pseudo-Random-Noise Bit Rate 0.01 bps to 10.0 Mbps
- Subcarrier Frequency / Internal Clock 0.01 hz to 10.0 Mhz
- External Analog Signal 10.0 hz to 6.0 Mhz
- Maximum Frequency for Coherent Modulation 10.0 Mhz
- Independent Modulator (rear panel) Outputs -30.0 dBm to +20.0 dBm in 0.1 dBm increments

- Inputs to the Summer are fixed at 75 ohm

4.0 Communications Protocol

- An RS-232 Serial COM port will be used to communicate with this device.
- Port settings are as follows:

Baud Rate:	9600
Data Bits:	8
Stop Bits:	1
Parity:	None

5.0 GUI Functionality

It is expected that users will want to reset the device to a known state. Default values for device start-up following a hard reset are noted.

The user will be able to set the following remote controllable features

- **PSK Modulator Options Selection Screen**
 - The following items will be used to select and set up the options for each of the four PSK modulator modules.
 - **PSK Modulator Select**
 - This is used to select a modulator which will then be able other items related to that modulator set and/or selected
 - All other entries for this modulator will be made not available if this modulator is not selected
 - This item defaults to Not Selected
 - **Modulator Signal Source**
 - These are used to select which source will be used to feed the modulator
 - Signal source may be one of following
 - Internal PseudoRandomNoise (PRN) Generator
 - External data and clock inputs
 - This item defaults to External data and clock inputs
 - **Data Rate**
 - This is used to enter the rate in Bits Per Second (bps) that the PRN Generator will create its signal
 - The data rate ranges from 0.01 bps to 9,999,999.99 bps
 - This item defaults to
 - PSK #1 2,000.0 bps
 - PSK #2 2,000.0 bps
 - PSK #3 2,000.0 bps
 - PSK #4 2,000.0 bps
 - **Subcarrier Frequency**
 - This is used to enter the subcarrier frequency in hertz (hz) for the modulator
 - The subcarrier frequency ranges from 0.01 hz to 9,999,999.99 hz
 - This item defaults to
 - PSK #1 16.0 khz

- PSK #2 16.0 khz
 - PSK #3 16.0 khz
 - PSK #4 16.0 khz
- **Rear Panel Output**
 - This are used to toggle the availability of the modulator signal for output to the rear panel on/off
 - This item defaults to ON
- **Modulation Output Enable**
 - This is used to select either modulation of the subcarrier (coherent or non-coherent) or no subcarrier modulation, i.e. continuous-wave (CW) signal.
 - This item defaults to BPSK coherent modulation
- **Modulator Output Signal Power**
 - This is used to enter the power level of the signal of the modulator that will appear at the rear panel
 - The power level ranges from -30.0 dBm to $+20.0$ dBm in 0.1 dBm steps.
 - This item defaults to $+10.0$ dBm
- **Input Code Conversion**
 - This drop down menu box is used to select which type of formatted signal is expected for input to the modulator
 - Input conversion requires the presence of a 0 degree clock input
 - This item is not available out if Internal is selected as the modulator signal source
 - The user may choose one of the following
 - NRZ-Level
 - NRZ-Mark
 - NRZ-Space
 - BIO-Level
 - BIO-Mark
 - BIO-Space
 - DM-Mark
 - DM-Space
 - BYPASS
 - This item defaults to NRZ-Level
- **Modulation Code**
 - This is used to select which type of formatted signal is to be output from the modulator
 - The user may choose one of the following
 - NRZ-Level
 - NRZ-Mark
 - NRZ-Space
 - BIO-Level
 - BIO-Mark
 - BIO-Space
 - DM-Mark
 - DM-Space
 - BYPASS
 - This item defaults to NRZ-Level
- **Input Polarity Data/Clock lines**
 - This is used to select the polarity of the input to the modulator code converter

- The user may choose one of the following
 - Data Normal / Clock Normal
 - Data Normal / Clock Inverted
 - Data Inverted / Clock Normal
 - Data Inverted / Clock Inverted
- This item defaults to Data Normal / Clock Normal
- **PseudoRandomNoise Pattern**
 - This is used to select the pseudo random noise generator pattern that will be used for the selected modulator if the PRN generator is selected as its input source
 - The user may choose one of the following
 - 2⁷Forward
 - 2⁹Forward
 - 2¹¹Forward
 - 2¹¹Reverse
 - 2¹⁵Forward
 - 2²⁰Forward
 - 2²³Forward
 - DOTS-01010
 - Tap-Select
 - This item defaults to 2¹¹Forward
- **PRN Register Tap Select**
 - This is used to enter a hex value string for the register tap seed.
 - PRN register taps correspond to each '1' in the sequence when the hex digits are expressed in binary form.
 - Register Tap hex value strings range from 0 to 7FFFFFF
 - This item is not available if Tap-Select is not selected under PseudoRandomNoise Pattern
 - This item defaults to 0
- **Apply Now**
 - This feature will cause the device to be set to the settings contained in the User Interface.
- **Reset**
 - This feature will perform an immediate reset of the device to its default hard-coded values.
- **Composite Signal Selection & Setup Screen**
 - The following items will be used to select and set up the component signals that will be sent to the signal summer for the creation of the composite output signal.
 - **Composite Signal Component Select**
 - This enables the user to select this source as a composite signal input.
 - The user may select up to four out of the seven to build a composite signal
 - All other entries for this source will be made not available if this source is not selected
 - This item defaults to Not Selected
 - **Composite Signal Attenuation**
 - This is used to set the attenuation for the of composite output signal
 - Attenuation ranges from 0.0 dB to 7.5 dB in 0.5 dB steps
 - This item defaults to 0.0 dB
 - **Input Signal Power**
 - This is used to input the power of this source input to the composite signal

- Power selection ranges from -30.0 dBm to $+20.0$ dBm
 - This item defaults to 0.0 dBm
- **Signal Toggle**
 - This is used to turn the signal on or off.
 - This item defaults to OFF
- **Apply Now**
 - This feature will cause the device to be set to the settings contained in the User Interface.
- **Reset**
 - This feature will perform an immediate reset of the device to its default hard-coded values.
- **Digital Synthesizer Options Screen**
 - The following items will be used to select and set up each of the two digital synthesizers.
 - **Digital Signal Source**
 - This menu box is used to select which signal will be used to drive the digital base band
 - The user may choose one of the following
 - Auxiliary Digital Input
 - PSK #1 Data Input
 - PSK #2 Data Input
 - PSK #3 Data Input
 - PSK #4 Data Input
 - This item defaults to Auxiliary Digital Input
 - **Digital Signal Output Polarity**
 - These are used to select the polarity of the output signal from the digital base band
 - User may select either of Normal polarity or Inverted polarity
 - This item defaults to Normal Polarity
- **Apply Now**
 - This feature will cause the device to be set to the settings contained in the User Interface.
- **Reset**
 - This feature will perform an immediate reset of the device to its default hard-coded values.

6.0 Command Scripting

See Appendix B: Scripting Requirements

7.0 High-level Status

It should be noted that this device does not feature parameter monitoring. It will need to be understood that the GUI will initiate communication / command with the device and will reflect the value(s) embedded in the device command string(s). The device will acknowledge that a command string was received, i.e. 'heard'. However, there is no way to confirm or otherwise verify that the command values were set.

8.0 Replacement Algorithm

Note that when power is first applied or following a power interruption the device will default to the operating parameters as defined in non-volatile memory. Particularly note too, that the device will revert

to local mode. Operator intervention will be required to place the device back into remote mode. The operator will have to manually select remote mode from the device's front panel keypad.

Operator intervention will be required to recover from loss of the device at the master console. Loss of the device will be indicated by a loss of responsiveness to commands. This device loss will be reflected on the Master Node control screen. At this time the Master device configuration table will have to be updated.

Appendix A: Graphical User Interface Requirements

The user will be able to access the following remote controllable features.

Appendix B: Scripting Requirements

Master	Node	Comments/Error Handling
Resource Request Specific Parameter: unit number	Start Check allocation table for unit number If available then Mark unit as assigned to this Master Reply "Unit # assigned" Open log file Retrieve configuration file from this Master Else Reply "Unit # not available" End	>> Insure that Remote is selected on the device's front panel display >> Issue an 'Alive' and listen for a response to indicate that unit is responding and available.
Resource Request General	Stop Start Check allocation table for an available unit using the least recently used method If available then Mark unit as assigned to this Master Reply "Unit # assigned" Open log file Retrieve configuration file from this Master Else Reply "No units available" End	>> Insure that Remote is selected on the device's front panel display >> Issue an 'Alive' and listen for a response to indicate that unit is responding and available.
Setup Parameter: unit number	Start Verify possession of unit by this Master	

Master	Node	Comments/Error Handling
	If not assigned to this Master then Inform this Master Stop End Load and Verify configuration file If configuration file error then Inform this Master Stop End Stop	>> Operator intervention required >> Operator intervention required
Start Support Parameter: unit number	Start Verify possession of unit by this Master If not assigned to this Master then Inform this Master Stop End Stop	>> Operator intervention required
Stop Support Parameter: unit number	Start Verify possession of unit by this Master If not assigned to this Master then Inform this Master Stop End Stop	>> Operator intervention required
Takedown Parameter: unit number	Start Verify possession of unit by this Master	

Master	Node	Comments/Error Handling
	<p>If not assigned to this Master then Inform this Master Stop End</p> <p>Mark unit as not assigned Close log file Send log file to this Master</p> <p>Stop</p>	<p>>> Operator intervention required</p>